

REMARKS

This Amendment is being submitted in response to the Final Office Action dated May 19, 2004, and is accompanied by a Petition for a Two-Month Extension of Time and a Request for Continued Examination and the related fees. The extended period for response expires on October 19, 2004. Accordingly, this Response is timely filed.

Reconsideration of this application, as amended, is respectfully requested. By this Amendment the limitation of former claim 28 is being incorporated into independent claim 1, claim 28 is being cancelled, and the dependency of claim 31 is being changed accordingly. The addition of "new matter" has been scrupulously avoided. Claims 1-27 and 29-31 remain in this case.

Initially, Applicants' attorney would like to thank the Examiner for the courtesy shown during the August 19, 2004 telephone interview. During this interview, the rejections of former claim 28 were discussed. The arguments presented are repeated below.

In the Office Action dated May 19, 2004, claim 28 was rejected under 35 U.S.C. 112, first paragraph, as allegedly failing to comply with the written description requirement. According to the Examiner, "There is no support in the disclosure as originally filed of forming the implanted region without changing the doping level of a portion surrounded by the trough."

In addition, claim 28 was rejected under 35 U.S.C. 112, first paragraph as allegedly failing to comply with the enablement requirement. According to the Examiner, "There is insufficient guidance to enable one of ordinary skill in the art to practice the invention of claim 28. Note the articles cited by Applicants and discussed in the Response filed 2/27/04. The Gaussian distribution of implanted ions would be thought to preclude such a step."

These rejections are respectfully, but most strenuously traversed. Former claim 28, and now amended claim 1, specify ion implantation with a high energy that assures that the trough enclose p-doped inner area which remains on a surface of the p-doped semiconductor substrate or the trough enclosed n-doped inner area which remains on a surface of the n-doped semiconductor substrate has a same doping concentration as the starting semiconductor substrate.

Support for this limitation will be found, in the original specification, on page 1 in the last paragraph where it is stated:

In the process described in the invention an n-doped trough is produced by high-energy implantation in the preferably weakly p-doped semiconductor substrate. The ion implantation is done using an energy that assures that a p-doped inner area remains on the surface of the semiconductor substrate, while the fringe area of the n-doped trough extends as far as the surface of the semiconductor substrate. (Emphasis added)

The term "remains" clearly connotes the continued existence of a preferably weakly p-doped area on the surface of the semiconductor substrate.

Further, on page 2 of the original specification, it is stated that:

On the basis of the semiconductor structure described in the foregoing, an NPN-transistor can be produced simply and without great cost in that a p-doped area with heavier doping than that of the semiconductor substrate is produced in the p-doped inner area of the semiconductor substrate. (Emphasis added)

The above description also indicates that the p-doped inner area has the same doping as the starting semiconductor substrate.

On page 5, last paragraph of the original specification, a preferred embodiment is described as follows:

Following creation of the mask which can be done using conventional processes, doping is done, preferably an implantation of phosphorus ions at a dose of, for example, 2×10^{13} atoms/cm², in order to create an n-doped trough 5 in the semiconductor substrate 1. The implantation energy in the process is such that over the trough 5 in the semiconductor substrate 1 there still remains a p-doped area 6. At a dose of 2×10^{13} atoms/cm² this is, despite the back-scattered phosphorus ions, for example, the case if the implantation energy is 6 MeV phosphorous ions. (Emphasis added)

The above quotation not only supports the continued existence of an inner area of the same doping concentration as the starting semiconductor substrate, but also provides an explanation for this phenomena and a specific example.

Furthermore, Applicants' original drawings (see, for example, Figures 1a-1c, 2a and 2b) clearly show that the inner area 6 above the trough 5 has the same weakly doped concentration (P⁻) as the starting substrate. See also the description, in the last paragraph on page 6 of the original specification, of the process depicted in Figures 2a-2d which describes implantation of a p-doped area 8 with heavier doping than that of the semiconductor substrate.

Accordingly, Applicants submit that the original specification and drawings clearly support the limitation of former claim 28 which is now incorporated into independent claim 1.

Applicants also wish to draw the Examiner's attention to two figures that were earlier submitted in this application. A duplicate of these figures is enclosed.

Fig. 1 shows the implantation energy as a function of the depth for an implantation dose of $1 \times 10^{15} \text{ cm}^{-2}$. The substrate doping is $1 \times 10^{15} \text{ cm}^{-2}$. The substrate doping is $1 \times 10^{15} \text{ cm}^{-3}$ and $2.5 \times 10^{15} \text{ cm}^{-3}$, respectively. It should be noted that the implantation dose of $1 \times 10^{15} \text{ cm}^{-2}$ and the substrate doping of $1 \times 10^{15} \text{ cm}^{-3}$ are the values as used by the Sakurai reference. As can be seen, if the implantation energy is 6 MeV, the doping in the surface area does not change. By contrast, if the implantation energy is 400 KeV as proposed by Sakurai, the doping will change. The upper inner area remaining on the substrate is designated with yellow highlighting. It is not possible to assure that the upper inner layer remains unchanged using an energy of 400 KeV as proposed by Sakurai.

Fig. 2 shows the implantation energy as a function of the depth for an implantation dose of $2.5 \times 10^{13} \text{ cm}^{-2}$ according to the high energy of the present invention (e.g. 6 MeV). The substrate doping is $1 \times 10^{15} \text{ cm}^{-3}$ and $2.5 \times 10^{15} \text{ cm}^{-3}$, respectively. At this high energy, the doping in the upper inner area of the substrate does not change. The use of such a high energy level is one of the features that distinguishes the present invention from the prior art.

Based upon the above submission, Applicants respectfully request that the rejections under 35 U.S.C. 112, first paragraph, be withdrawn.

Claim 28 was not rejected on prior art. Accordingly, claim 1, which now incorporates the limitations of former claim 28, is believed to be in condition for allowance. Such action is respectfully requested.

The dependent claims are allowable for the same reasons as independent claim 1 from which they all ultimately depend, as well as for their additional limitations. There is, for example, no suggestion in the applied prior art for the energy level specified in claims 29 and 30 or for the low doping concentration of the starting semiconductor substrate as specified by claim 31.

For all of the above reasons, this application is believed to be in condition for allowance and such action is respectfully requested.

If it would advance the prosecution of this application, the Examiner is invited to contact Applicants' representative at the below indicated telephone number.

Respectfully submitted,

A handwritten signature in black ink that reads "Jeff Rothenberg". The signature is written in a cursive style with a long horizontal stroke at the end.

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